

Framingham District
Bulk Substation Transformer Outages
Distribution Supply Line Outages
Thermal Results and Remedial Switching Actions

2004 T&D OPERATING STUDY FRAMINGHAM DISTRICT

STATION #126 HOPKINTON

Hopkinton Station #126 supplies a portion of the town of Hopkinton. During the summer of 2022, Hopkinton peak load was 44 MVA. Hopkinton Station consists of two 115/13.8 kV transformers:

Transformer #110A: North American 24/32/40 MVA 117/14.4 kV

Transformer #110B: North American 24/32/40 MVA 117/14.4 kV

Hopkinton Station #126 total capacity is 80 MVA. NSTAR employs summer emergency rating (cyclic capability) of 40.1 MVA for each of these two banks. Station #126's firm capacity is 40.1 MVA. Hopkinton Station #126 has approximately 17.4 MVA of RADSEC transfer switching to adjacent stations Medway #65 and West Framingham #455. Hopkinton's load carrying capability is 57.5 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	24/32/40 MVA	47 MVA	43 MVA
110B	24/32/40 MVA	47 MVA	43 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
80 MVA	40.1 MVA*	15.3 MVA	0 MVA	55.4 MVA

*Based upon loss of 110A/126-502 or 110B/126-501.

2004-2008 Projected load:

2004	2005	2006	2007	2008
46 MVA	52 MVA	56 MVA	58 MVA	61 MVA

Switching Actions:

Loss of Transformer #110A and 126-502 Line:

Open: GCB #2 @ Milford
Circuit Switcher CS770
Main 110A 13.8kV Secondary Circuit Breakers
Close: ABR Scheme Closes 13.8kV Bus Tie Breaker
Manually close GCB #2 @ Milford

Loss of Transformer #110B and 126-501 Line:

Open: GCB #1 @ Milford
 Circuit Switcher CS771
 Main 110B 13.8kV Secondary Circuit Breakers
Close: ABR Scheme Closes 13.8kV Bus Tie Breaker
 Manually close GCB #1 @ Milford

For loss of either transformer, transfer of the following DSS lines via RADSEC switches would also be required:

Hopkinton 126-H3 to Medway 65-H6 via RADSEC MRU 457 on P12/105 for a transfer of 7.1 MVA
 Hopkinton 126-H2 to Medway 65-H2 via RADSEC MRU 459 on P 35/38 for a transfer of 3.1 MVA
 Hopkinton 126-H4 to W. Framingham 455-H3 via RADSEC MRU 264 on P122/1 for a transfer of 5.1 MVA

Total Transfer: 15.3 MVA

Summary of Concerns:

1. Hopkinton Station #126 is overloaded under contingency conditions (2006)

EMC is the largest customer supplied by Hopkinton Station #126 and the station loading is highly dependent on the activities at EMC. The EMC region of Hopkinton continues to grow. EMC has completed the expansion of their South Street campus, which would likely result in the addition of significant load when fully occupied. The growth of EMC load is dependent on the economy and technology sector in particular, and may accelerate or delay the need for additional transformation at Hopkinton #126. It is anticipated that the proposed EMC expansion will add potentially 20 MVA of new load prior to the Summer 2006. The new EMC load in combination with the modest load growth within the remainder of the Hopkinton supply area will strain the capability of Hopkinton #126's substation and distribution infrastructure to support the customer load requirements.

Based on load projections should the known EMC projects occur there is a potential for more than 17 MVA, starting in the summer of 2006 for a single-contingency outage of either transformer 110A or 110B, Hopkinton Station #126 will exceed the load carrying capability (1% over LTE, 0.6 MVA load risk).

Distribution Systems

DSS Lines

The majority of the load growth within the Hopkinton supply region is attributable to EMC with only a modest load growth within remaining supply region. There are there four line groups that supply EMC Corporation. The capacity of the DSS lines supplying EMC will be adequate to meet the planned expansion. Considering the modest load growth the distribution circuits will have sufficient capability.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk	LTE - % Load at Risk 2008	MVA at Risk
265-1380	Future line	0%	0	0%	0
265-1381	30%	0%	0	0%	0
265-1385	Future line	N/A	0	0%	0

265-1386	25%	N/A	0	0%	0
314-1370	25%	0%	0	0%	0
314-1371	15%	0%	0	0%	0
587-1365	60%	0%	0	0%	0
587-1366	42%	0%	0	0%	0

Loading on Hopkinton DSS lines.**14 kV Distribution**

There are four distribution circuits supplied from Hopkinton Station #126. Considering the modest load growth the distribution circuits will have sufficient capability. Presently 126-H1 is heavily loaded, as the load growth continues NSTAR can be relieve this heavily loaded circuit to the adjacent circuit 126-H4.

14kV Radial Line	% of Normal 2002	Projected % of Normal 2004	Projected% of Normal 2008
126-H1	85%	86%	87%
126-H2	63%	64%	66%
126-H3	27%	27%	28%
126-H4	45%	46%	46%

Loading on Hopkinton Distribution Circuits.**Proposed Integrated Plan**

The suggested actions in the table will address the concerns within the Hopkinton supply region. The primary focus of the plan will be to increase the transformer capacity at Hopkinton Station #126 in a timely manner to support the future EMC expansion. Replacing the existing transformers with new larger 115/14kV transformers will provide the foundation for all the Hopkinton area capacity needs beyond 2013. The DSS and distribution infrastructure has sufficient capability to support the anticipated increase in load.

Action	Year needed	Cost
⇒ Relieve 126-H1 to adjacent distribution circuit 126-H4	2006- 2008	None
⇒ Replace Hopkinton #126 transformers 110A and 110B with two new 62.5 MVA load tap changing transformers or relieve the station by load transfers to the adjacent circuits.	2006	TBD

LL# (617)-541-1949

TWO "A" SWITCHES ARE USED TO PASS "A" UNIT PASS THROUGH THEIR OWN BARRELS ENCLOSE WITHIN THE "B" COMPARTMENT. ALL POWER LINES ARE BOTTOM ENTRY.

THE BREAKER IN UNIT 8 RUNS NORMALLY OPEN AND CLOSERS ON 1055 V
LIVA OR E OR 115 KSV LINE

* THE CFT SECONDARY BREAKER MUST BE OPEN AND THE KEY RETRIEVED BEFORE THE ASSOCIATED FUSE DRAWER CAN BE OPENED.

© - CUPLED WITH SHINE TRIP - EVIL

ALL 30KV BREAKERS ARE OF TYPE VE 570VVA 11.

ANALYTICAL SYSTEM

GLOBAL CONTROL IS VIA INTEGRATION SYSTEM



TEMP

11

22:EI 1P 20/02/20 GMP02|E|5\VTTP\5

2004 T&D OPERATING STUDY FRAMINGHAM DISTRICT

STATION #240 FRAMINGHAM

Leland Street Station #240 supplies portions of the communities of Framingham, Natick, Sherborn and Dover. During the summer of 2002, Framingham peak load was 76 MVA.

Framingham Station consists of two 115/13.8 kV transformers:

Transformer #110A: Westinghouse 24/32 MVA 115/13.8 kV

Transformer #110C: Westinghouse 24/32 MVA 115/13.8 kV

Framingham Station #240 total capacity is 64 MVA. A July 2003 oil quality and dissolved gas analysis identified deteriorating physical conditions for both the transformer 110A and 110C. Considering the languish condition, transformer 110A and 110C have no overload capability and reduces Station #240's firm capacity to 32 MVA. Though there is significant transfer switching to adjacent stations, approximately 17.8 MVA, the majority is comprised of manual switching. The station has three 13.8 kV generators owned and operated by Exelon, two of which are assumed to be available to support the station's distribution load and is included in the calculation of Station 240's load carrying capacity. Leland's load carrying capability (LCC) is (i.e. transformer firm capacity + two Exelon jets + transfer switching) is 32 + (20)+17.8 or 69.8 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour L.T.E. 90F Ambient	12 hour L.T.E. 110F Ambient
110A	24/32 MVA	32 MVA	32 MVA
110C	24/32 MVA	32 MVA	32 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (L.T.E.)	RADSEC Transfer	Manual Transfer	Total LCC
64 MVA	52 MVA (A)	6.3 MVA	11.5 MVA	69.8 MVA

(A) Firm Capacity includes the dispatch of 2-14 kV Sithe Framingham generators at 10 MVA each.

2004-2008 Projected load:

2004	2005	2006	2007	2008
73 MVA	74 MVA	76 MVA	77 MVA	78 MVA

Note A: The projected loads reflect the permanent load transfer of 8 MVA from Framingham Station #240 to Speen Street Station #433.

Switching Actions:

Loss of Transformer #110A:

- Open:** Circuit Breakers #1, #4, and #7 in 115kV Ring
Disconnect Switch #T730
Main 110A 13.8kV Secondary Circuit Breaker
- Close:** 13.8kV Bus Ties Normally Closed
Manually close OCB's #1, #4, and #7 in 115kV Ring

Loss of Transformer #110C:

- Open:** Circuit Breakers #8 and #9 in 115kV Ring
Disconnect Switch #731
Main 110C 13.8kv Secondary Circuit Breaker
- Close:** 13.8kV Bus Ties Normally Closed
Manually close OCB's #8 and #9 in 115kV Ring

For loss of either transformer, transfer of the following DSS lines via RADSEC switches may also be required:

Framingham 240-H3 to West Framingham 455-H5 via manual switch on P244/75 and RADSEC switch on P479/16 for a peak transfer of 2.1 MVA.

Framingham 240-H3 to Speen St 433-H8 via RADSEC switches on P53/79 and P53/51 for a peak transfer of 3.6 MVA.

Framingham 240-H3 to Speen St 433-H12 (via 240-H2) via RADSEC switch on P279/74 and Station Breaker 240-H3 for a peak transfer of 2.7 MVA.

Framingham 240-H4 to Sherborn 519-75H via manual switch on P347/0 and Station Breaker 240-H4 for a peak transfer of 4.4 MVA.

Framingham 23-H1 to Speen St 433-H5 via manual switches on P137/32 and P206/22 for a peak transfer of 2.7 MVA.

Framingham 23-H1 to Speen St 433-H7 via manual switch on P206/56 and RADSEC switch on P19/42 for a peak transfer of 2.3 MVA.

Total Transfers: 17.8 MVA

Summary of Concerns:

1. Framingham Station #240 is overloaded under contingency conditions (2004)
2. Poor voltage regulation (2004)
3. Reliability of on-site generation to support load (2004)
4. Circuit 240-H2 overloaded under normal conditions (2004)
5. Circuit 240-H3 overloaded under normal conditions (2004)
6. 4 kV stations Natick #23 and Framingham #24 overloaded under contingency conditions (2004)
7. 4 kV lines 24-04 and 24-05 overloaded under normal conditions (2004)
8. Both transformers connected to same bus at Natick #23, reliability concern
9. Framingham line group slightly overloaded under contingency conditions (2008)

The Framingham supply region continues to experience modest load growth. In the summer of 2003 the region's load was 74 MVA. The projected new load will strain the capability of Leland Street Station #240 to support customer load requirements. With the planned additional load increase, the loss of either transformer 110A or 110C may exceed the capability of Leland Station #240 as early as

the year 2004. The load at risk is 12.2 MW in year 2004. To reduce this heavy load condition, 8 MVA of load was permanently transferred from Framingham Station #240 and Speen Street Station #433. During the past few years the Exelon 13.8KV generators have been unreliable, frequently unavailable for service or failed to operate. The unavailability of Exelon 13.8 kV generators would substantially increase the load at risk.

The existing 115/14kV transformers at Leland Street, Station #240 are non-regulating transformers. As result of this lack of voltage regulation capability, customers near the end of some of the distribution circuits supplied from Leland Street Station #240 experience voltage problems throughout the year.

During the summer of 2002, the 14 kV bus voltages fluctuated from a high of 123.6 to a low of 114V (1.03 pu to 0.95 pu). Statistical analysis of 2001 and 2002 summer daytime bus voltages yielded the following results:

Probability of bus voltage < 0.95 Pu = 1.64%
 Probability of bus voltage < 0.97 Pu = 17.8%
 Probability of bus voltage < 0.99 Pu = 61.5%
 Probability of bus voltage < 1.00 Pu = 81.5%

The ANSI C84 Standard states that during non-contingency conditions, the customers must have between 114V – 128V (0.95 pu – 1.05 pu). Computer models of the Framingham #240 circuits revealed that during light to moderate loads, the voltage drop from the substation to the end of the circuit ranges between 4% and 7%. Under heavy loading conditions, as experienced several times in the summer of 2002, the voltage drop ranges from 6% to 11%.

In order to comply with the ANSI C84 Standard at this station, the minimum bus voltage must remain in the 122V to 126V range (1.02 pu – 1.05 pu).

Distribution Systems

DSS Lines

The Framingham line group is composed of DSS lines 24-1348, 24-1340 and 24-1337. Upon the loss on one of either 24-1348 or 24-1337, the other lines will exceed their long-term emergency capacity (LTE) by a small amount beginning in 2008, based on 2004-2008 load projections. Line 24-1337 has been identified as a poor performer based on the number of number of cable failures since 1998.

DSS Line	% of Normal 2004	LTE - Load at Risk 2004	LTE - Load at Risk 2008
24-1348	87%	0	300 kVA
24-1340	79%	0	0
24-1337	94%	0	100 kVA
23-1338	90%	0	0
23-1345H	69%	0	0
328-1339	87%	0	0
125-110	27%	0	0

Loading on Framingham DSS lines.

14 kV Distribution

Three of the five distribution circuits fed from Framingham #240 have adequate capacity. One line,

240-H2, reached 95% of its normal capacity with all lines in service, and will likely exceed its normal capacity beginning in 2004. 240-H3 a significant portion of the line is 2/0 CU conductor and must be reconducted with 3-336 AL conductor. The difference in ampacity between 336-AL and 2/0 CU based on the Boston Edison Standard 2.4-1.3 is between 110A and 135A.

In addition to the Framingham #240 lines, there are two 14 kV distribution circuits fed from Natick #23 (Mechanic Street) and one fed from Framingham #24 (South Street). The loading on these eight lines is shown in the following table. Circuit 23-H2, which is direct buried and had poor reliability in the past, is now only used as a backup.

14 kV Circuit	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
23-H1	26%*	80%	82%
23-H2	2%	2%	2%
24-H1	56%	62%	66%
240-H1	59%	65%	70%
240-H2	95%	105%	112%
240-H3	96%	107%	113%
240-H4	66%	73%	77%
240-H5	79%	88%	93%

Loading on 14 kV distribution circuits.

(*Load transfer to station)

4kV Substation

Framingham #240 feeds two 4 kV stations: Natick #23 (Mechanic Street) and Framingham #24 (South Street). Natick #23, upon the loss of one of its two 5 MVA transformers, will exceed its long-term emergency capacity by 18% or more under heavy loading conditions. The load at risk in this event is over 1 MVA. In addition, since both transformers are connected to the same bus, the loss of a bus could result in an extended outage for much of downtown Natick. Framingham #24 has two 5 MVA transformers and one 6 MVA transformer. Upon the loss of the 6 MVA transformer the remaining transformer will likely exceed their long-term emergency ratings by 11% under heavy loading conditions, with a potential of over 1.3 MVA load at risk. The following table summarizes the capacity of these 4 kV stations.

4 kV Station	2002 Peak	LTE Capacity	2004 Projection	2008 Projection
Natick #23	6.9 MVA	6 MVA	7.1 MVA	7.3 MVA
Framingham #24	13.1 MVA	12 MVA	13.3 MVA	13.9 MVA

Loading on 4 kV stations fed from Framingham #240

Proposed Integrated Plan

The suggested actions in the table will address the concerns within the Framingham supply region. The primary focus of the plan will be to start the modernization of Framingham Sta #240 by replacing the existing transformers with new 62.5 MVA LTC 115/14kV transformers and at least one section of new distribution switchgear. Replacing the existing transformers with new larger 115/14kV transformers will provide the foundation for all the Framingham area capacity needs beyond 2008. The new transformers have voltage regulation and would address both the potential

voltage concerns and the reliance on increasing unreliable Exelon 14kV generators. The new switchgear will provide addition feeder positions to supply the increased load in the region and allow the continued conversion of the 4 kV distribution system. The installation of new distribution circuits will also create additional transfer capabilities with Sherborn Sta #274 and Speen Street Sta #433.

Action	Year needed	Cost
⇒ Replace Framingham Sta #240 transformers 110A and 110C with two new 62.5 MVA load tap changing transformers	2004	\$4Mil
⇒ Convert 4 kV circuit 23-02 through 14 kV circuit 23-H1; use 23-02 as backup to 23-04 and 23-05.	2004	\$215K
⇒ Convert 23-06 through a new Framingham Sta#240 circuit to relieve heavy loading of Natick Sta #23	2004	\$500K
⇒ Reconductor portion of 240-H2	2004	\$330K
⇒ Reconductor portion of 240-H3	2004	\$270K
⇒ Install fans on the transformers at Framingham Sta #24.	2004	\$50K
⇒ Install a new Framingham Station #240 circuit to relieve the Framingham Line group or reconductor the lines in the Line Group	2008	\$TBD

2004 T&D OPERATING STUDY FRAMINGHAM DISTRICT

STATION #274 SHERBORN

Sherborn Station #274 supplies portions of the communities of Framingham, Sherborn, Ashland and Holliston. During the summer of 2002, Sherborn peak load was 51 MVA.

Sherborn Station #274 consists of two 115/13.8 kV transformers:

Transformer #110A: Cooper Power Systems 24/32/40 MVA 115/14.4 kV

Transformer #110B Cooper Power Systems 24/32/40 MVA 115/14.4 kV

Sherborn Station #274 total capacity is 80 MVA. NSTAR employs summer emergency rating (cyclic capability) of 41 MVA for each of these two banks. Station #274's firm capacity is 41 MVA.

Sherborn Station #274 has approximately 20 MVA of transfer switching to adjacent stations Medway #65, Hopkinton Sta #126, Framingham Sta #240, Speen Street #433 and West Framingham #455.

Sherborn's load carrying capability is 70 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	24/32/40 MVA	49 MVA	44 MVA
110B	24/32/40 MVA	49 MVA	45 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
80 MVA	41 MVA*	6.2 MVA	17 MVA	64.2 MVA

* Based upon loss of 110B/240-508 Line.

2004-2008 Projected load:

2004	2005	2006	2007	2008
52 MVA	53 MVA	53 MVA	54 MVA	55 MVA

Switching Actions:

Loss of Transformer #110A and 274-509 Line:

- Open:** OCB's 7 & 8 @ Medway
 OCB #1
 Circuit Switcher #CS773
 Main 110A 13.8kV Secondary Circuit Breaker
- Close:** Manually close 13.8kV Bus Tie Breaker
 Manually close OCB #1

Manually close OCB's 7 & 8 @ Medway

Loss of Transformer #110B and 240-508 Line:

Open: OCB's 3, 5 & 9 @ Framingham

OCB #2

Circuit Switcher #CS772

Main 110B 13.8kV Secondary Circuit Breaker

Close: Manually close 13.8kV Bus Tie Breaker

Manually close OCB #2

Manually close OCB's 3, 5 & 9 @ Framingham

For loss of either transformer, transfer of the following DSS lines via RADSEC and/or manual switches may also be required:

Sherborn 274-H2 to Medway 65-H3 via RADSEC switch on P76/13 and RADSEC switch on P2/11 for a peak transfer of 2.4 MVA.

Framingham 240-H1 to Framingham 23-H2 via RADSEC switches on P18/51 and P204/15 for a peak transfer of 3.6 MVA. This load is not removed from Sherborn, however it creates capability for transfers below.

Sherborn 274-H4 to Speen St 433-H12 (via 240-H2) via manual switches on P227/27 and P14/34 for a peak transfer of 3.7 MVA.

Sherborn 274-H4 to Framingham 240-H1 via RADSEC switches on P31/13 and P15/22 for a peak transfer of 3.8 MVA

Sherborn 65-1325H1 to Hopkinton 126-H2 via manual switch on P36/32 and RADSEC switch on P6/32 for a peak transfer of 6.0 MVA.

Sherborn 65-1325H6 to West Framingham 455-H3 via manual switch on P3/32 and RADSEC switch on P26/26 for a peak transfer of 7.3 MVA.

Total Transfer: 23.2 MVA

Summary of Concerns:

1. Sherborn #274 14 KV distribution circuits are capacity constrained for all lines in (2004-2006)

Without any significant major development projects planned during the 2004-2008, the Sherborn Supply region is projected to experience meager load growth; approximately 1.1%. Based on the load projections, by the summer of 2008 for a single contingency outage of either transformer 110A or 110B, Sherborn Station #274 has adequate capacity to meet the load requirements and would be loaded to 86% of the load carrying capability.

Distribution Systems

DSS Lines

The Ashland line group is composed of DSS lines 65-1325H, and 239-1429. Upon the loss on one of either of these DSS lines, the other lines will not exceed their long-term emergency capacity (LTE), based on 2004-2008 load projections. Line 519-75H is a radial DSS line that supplies customer Station #519 AT&T on Waverly Street, Framingham. This line has sufficient capability to supply the customer load.

DSS Line	% of Normal 2004	LTE - Load at Risk 2004	LTE - Load at Risk 2008
65-1325H	60%	0	0
519-75H	82%	0	0
239-1325H	75%	0	0

Loading on Sherborn DSS lines.

14 kV Distribution

The three distribution circuits fed from Sherborn #240 are heavily loading and are projected to exceed the normal rating under all lines in conditions.

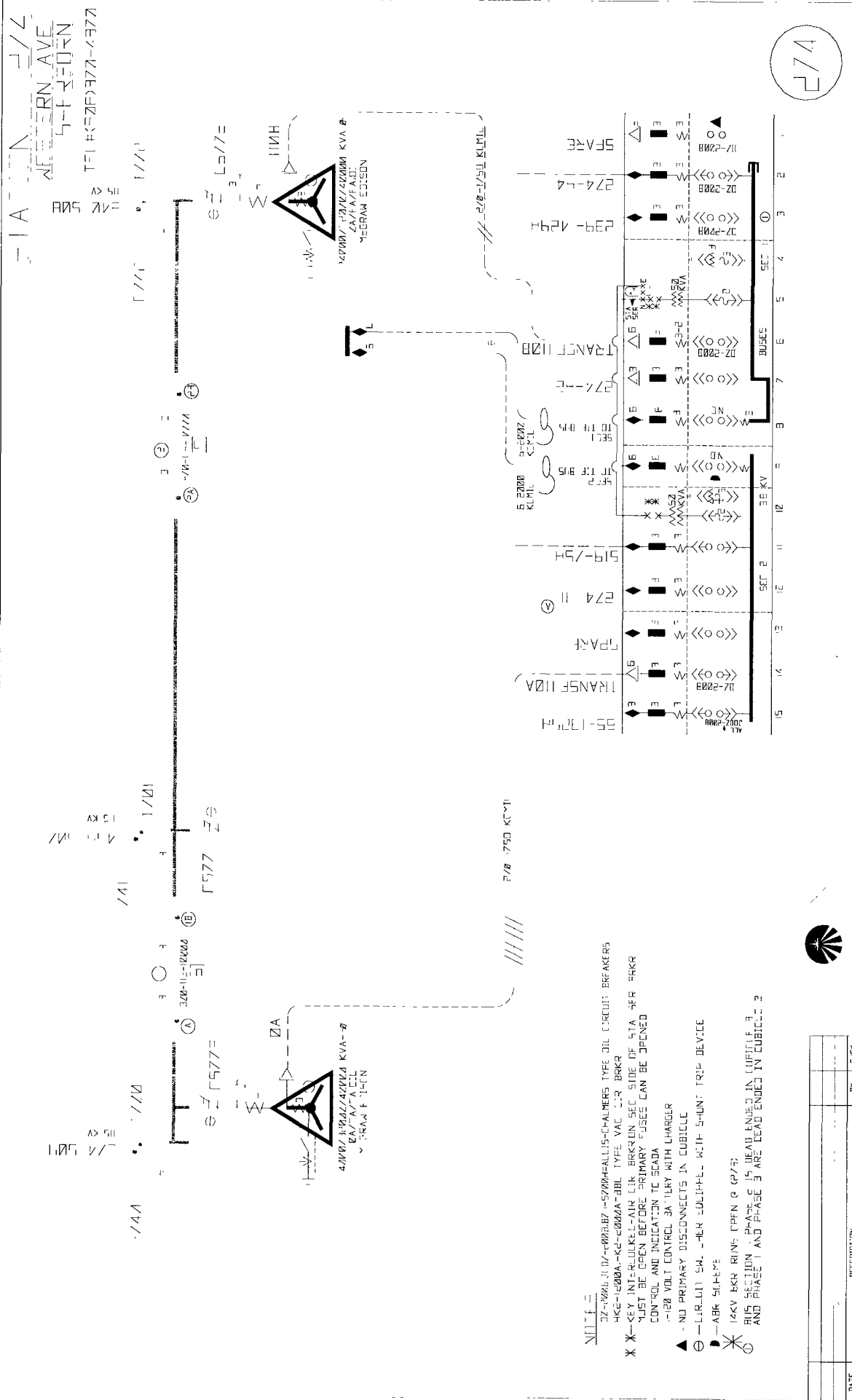
14 kV Circuit	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
274-H1	96%	98%	103%
274-H2	95%	100%	105%
274-H4	95%	96%	102%

Loading on Sherborn distribution circuits.

Proposed Integrated Plan

The suggested action in the table will address the concerns within the Sherborn supply region. Sherborn Sta #274 has adequate transformer capacity and transfer switching to adjacent stations to support the projected meager load growth beyond 2008. Sherborn Station #274 has three spare feeder positions that can support the installation of new circuits that would relieve the heavily loaded 14 kV distribution circuits.

Action	Year needed	Cost
⇒ Install two new distribution circuits at Sherborn #274 to relieve 274-H1, 274-H2 and 274-H4	2004-05	\$1.2 M



2003 T&D OPERATING STUDY FRAMINGHAM DISTRICT

STATION #342 SUDBURY

Sudbury Station #342 serves a power supply area consisting of the towns of Sudbury, Wayland and a portion of Framingham. During the summer of 2002, Sudbury Station #342 peak load was 39 MVA.

Sudbury Station #342 consists of two 115/13.8 kV step-down transformers:

Transformer #110A: VA Tech 37.5/50/62.5 MVA 117/14.4 kV

Transformer #110B Westinghouse 18/24 MVA 110/13.8 kV

A February 2003 oil quality and dissolved gas analysis identified deteriorating physical condition for the transformer 110A. Considering the languish condition, transformer 110A has no overload capability and reduced Station #342's firm capacity to 24.0 MVA. Project 03320 was approved to replace the Sudbury #342 transformers and distribution switchgear. Transformer 110A was replaced in June 2003, while transformer 110B will be replaced at a later date.

With the replacement of transformer 110A, Station #342 total capacity is 86.5 MVA. NSTAR employs summer emergency rating (cyclic capability) for each of these two banks; transformer 110A has a 75 MVA LTE rating while transformer 110B has a 29 MVA LTE rating. Station #342's firm capacity is 29 MVA. Sudbury Station #342 has approximately 14 MVA of transfer switching to adjacent stations Lexington #320, Speen Street #433 and Maynard #416. Sudbury's load carrying capability is 43 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	37.5/50/62.5MVA	87.6 MVA	80.1 MVA
110B	18/24 MVA	33 MVA	31 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
86.5 MVA	29 MVA*	14.0 MVA	7.9 MVA	50.9 MVA

* Based upon loss of 110A.

2004-2008 Projected load:

2004	2005	2006	2007	2008
40 MVA	41 MVA	42 MVA	42 MVA	43 MVA

Switching Actions:

Loss of Transformer #110A:

- Open:** Circuit Breakers #1 and #2
Main 110A 13.8kV Secondary Circuit Breaker
Manually open T725 disconnect
- Close:** 13.8kV Bus Tie Operated Normally Closed
Manually close OCB's #1 and #2 to close 115kV ring

Loss of Transformer #110B:

- Open:** Circuit Breakers #4 and #5
Main 110B 13.8kV Circuit Breaker
- Close:** 13.8kV Bus Tie Operated Normally Closed
Circuit Breakers #4 and #5 to close 115kV ring

For loss of either transformer, transfer of the following DSS lines via RADSEC switches may also be required:

Sudbury 342-H1 to Lexington 320-H1 via RADSEC MRU on P16/59 for a transfer of 5.7 MVA.

Sudbury 342-H3 to Speen Street 433-H6 via RADSEC MRU 836 on P 28/50 and RADSEC switch on P276/84 for a transfer of 2.3 MVA

Sudbury Sta #342 to Speen Street Sta #433 via opening SCADA controlled station breakers for 278-1347H at Saxonville Station #278 and 278-1343at Sudbury Sta #342 for a peak transfer of 3.0 MVA.

Sudbury 342-H4 to Speen Street 433-H4 via RADSEC switch on P75/13 and a manual switch on P 224/82 for a transfer of 1.2 MVA.

Sudbury 342-H4 to Speen Street via 278-H1 via RADSEC switch on P69/45 for a peak transfer of 7.2 MVA.

Maynard 416-H7 to Maynard 416-H6 via RADSEC switches on P9/1 and P6/3 for a peak transfer of 3.4 MVA. This load is not removed from Sudbury, however it creates capability for transfers below.

Sudbury 342-H2 to Maynard 416-H7 via RADSEC switch on P2/65 for a transfer of 6.0 MVA.

Total Transfer: 21.9 MVA

Summary of Concerns:

1. Radial line 342-H4 heavily loaded approaching Normal ratings under normal conditions (2008)

Without any significant major development projects planned during the 2004-2008, the Sudbury Supply region is projected to experience meager load growth; approximately 1.7%. Based on the load projections, by the summer of 2008 for a single contingency outage of either transformer 110A or 110B, Sudbury Station #342 would attain a loading of 85% of the load carrying capability.

Upon the completion of Project 03320 Station's #342 total capacity will be 125 MVA. Station #342's firm capacity will be 75.0 MVA and the transfer switching capability to adjacent stations is approximately 21.9 MVA. Sudbury's load carrying capability (i.e. firm capacity + transfer switching) is 96.9 MVA.

Distribution Systems**DSS Lines**

The Saxonville Line Group consists of three DSS lines, 278-1343H, 278-1346 and 278-1347H. The line group is a loop supply between Sudbury Station #342 and Speen Station #433. The line group supplies NSTAR Station #278 Lake Road, Saxonville, Framingham and customer Station #338, Congress Group Ventures, Wayland. Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2002 peak loads. The following table provides details on the Sudbury line 278 --1343H.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	LTE - % Load at Risk 2008
278-1343H	45%	0%	0%

Loading on Sudbury DSS line.

14 kV Distribution

Project 03179 created a new distribution circuit 342-H6 to supply a portion of the load presently supplied by Maynard Station #416. Circuit 342-H6 will be equipped with RADSEC controlled switches to increase the transfer switching at Maynard Station #416.

The six distribution circuits fed from Sudbury #342 will have adequate capacity. By 2008 one circuit 342-H4 is projected to attain 99% of its normal capacity with all lines in service. This heavy loading condition will be address by load transfers to adjacent Sudbury distribution circuits. There are no 4 kV stations/circuits fed from this station.

14 kV Radial Line	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
342-H1	67%	69%	74%
342-H2	55%	57%	62%
342-H3	80%	82%	86%
342-H4	91%	94%	99%
342-H5	69%	71%	78%

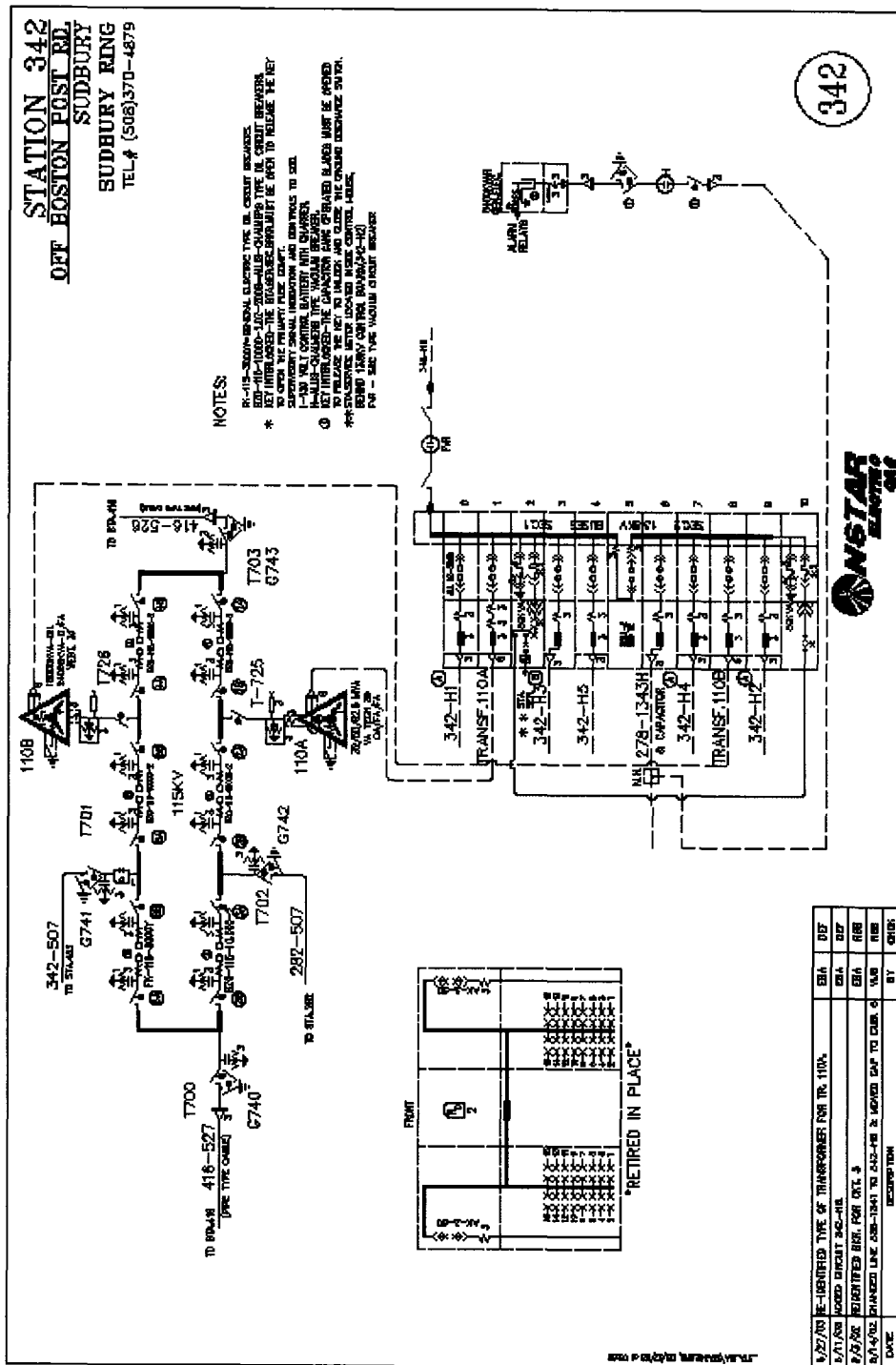
Loading on 14 kV distribution circuits.

Proposed Integrated Plan

The suggested actions in the table will address the concerns within the Sudbury supply region. The primary focus of the plan will be to modernize Sudbury Sta #342 by replacing transformer 110B and the distribution switchgear. Replacing the existing transformers with new larger 115/14kV transformers will provide the foundation for all the Sudbury area capacity needs beyond 2008. Sudbury Station #342 with 75 MVA of firm capacity has ample transformer capacity to be the foundation of an integrated plan to support the Sudbury-Maynard-Speen Street region's load beyond 2008. The new distribution switchgear will provide spare feeder positions that can support new circuits that would relieve the heavily loaded 14 kV distribution circuits and to increased transfer switching between Sudbury, Speen Street and Maynard.

Action	Year needed	Cost
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⇒ Replace Sudbury #342 transformers 110B with a new 62.5 MVA load tap changing transformer and replace the distribution switchgear	2004	\$1.9 Mil
⇒ Relieve 342-H4 by either installing a new Sudbury distribution circuit or load transfers to adjacent circuits within the Sudbury supply region.	2008	No Cost



FRAMINGHAM DISTRICT

STATION #416 MAYNARD

Maynard Station #416 serves a power supply area consisting of the towns of Acton and Maynard. During the summer of 2002, Maynard Station #416 peak load was 80 MVA

Maynard Station #416 consists of two 115/13.8 kV step-down transformers:

Transformer #110A: McGraw-Edison 30/40/50 [56] MVA 115/14.4 kV

Transformer #110B McGraw-Edison 30/40/50 [56] MVA 115/14.4 kV

Maynard Station #416 total capacity is 112 MVA. NSTAR employs summer emergency rating (cyclic capability) of 60 MVA for each of these two banks. Station #416's firm capacity is 60 MVA. Maynard Station #416 has approximately 21 MVA of transfer switching to adjacent station Sudbury Sta #342. Maynard's load carrying capability is 81 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	30/40/50 [56] MVA	69 MVA	64 MVA
110B	30/40/50 [56] MVA	69 MVA	64 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
48 MVA	60 MVA*	19.6 MVA	0 MVA	79.6 MVA

* Based upon loss of 110A/416-526 or 110B/416-527.

2004-2008 Projected load:

2004	2005	2006	2007	2008
82 MVA	81 MVA	82 MVA	83 MVA	85 MVA

Switching Actions:

Loss of Transformer #110A, 416-526 Line and 219-532 Line:

Open: OCB's 1 & 4 @ Sudbury
 Circuit Switcher #CS773
 Main 110A 13.8kV Secondary Circuit Breaker
Close: 13.8kV Bus Tie Operated Normally Closed
 Manually close OCB's 1 & 4 @ Sudbury

Loss of Transformer #110B, 416-527 Line and 219-533 Line:

Open: OCB's 3 & 6 @ Sudbury
Circuit Switcher #CS774
Main 110B 13.8kV Circuit Breaker
Close: 13.8kV Bus Tie Operated Normally Closed
Manually close OCB's 3 & 6 @ Sudbury

Note: For loss of either transformer, circuit 416-H4 will trip automatically within 30 minutes if total station load is 3000 Amps or greater.

For loss of either transformer, transfer of the following DSS lines via RADSEC switches may also be required:

Maynard 416-H6 to Sudbury 342-H6 via RADSEC switch on P9/1 and the SCADA controlled station breaker for 416-H6 for a transfer of 9.2 MVA.

Maynard 416-H3 to Maynard 416-H6 via RADSEC switches on P 73/51 and P127/3 for a transfer of 1.0 MVA

Maynard 416-H7 to Sudbury 342-H2 via RADSEC switches on P2/65 and P2/84 for a transfer of 5.1 MVA

Maynard 416-H7 to Sudbury 342-H1 via RADSEC switches on P88/3 and the SCADA controlled station breaker for 416-H7 for a transfer of 4.3 MVA.

Total Transfer: 19.6 MVA

Summary of Concerns:

1. Maynard Station #416 is overloaded under contingency conditions (2004)
2. Acton line group overloaded under contingency conditions (2004)

Without any significant major development projects during 2002-2008, the Maynard Supply region is projected to experience meager load growth; approximately 1.2% annual load growth. As a result of this small load growth based on load projections, starting in the summer of 2004 for a single-contingency outage of either transformer 110A or 110B, Maynard Station #416 will exceed the load carrying capability (3% over LTE, 2.4 MVA load risk). Between 2004-2008 there is the potential for 3 MVA of new load and the station could attain a loading of 111% of LCC. The load at risk would increase to 8.3 MVA.

Distribution Systems

DSS Lines

Maynard Station #416 has two line groups; the Acton and Maynard line groups.

The Acton Line Group consists of DSS lines 307-1351H and 307-1352H. The line group supplies customer Stations #307. Both lines have distribution circuits tapped off the lines. Upon the loss of either DSS lines, the remaining DSS line will exceed the long-term emergency capacity (LTE), based on 2002 peak loads.

The Maynard Line Group consists of three DSS lines, 207-1377, 207-1378 and 532-1386. The line group supplies customer Stations #207, 332 532 and NSTAR Station #355 Acton Street, Maynard.

Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2002 peak loads.

DSS Line	% of Normal 2004	LTE - % Ratings 2004	Load/ MW at Risk	LTE - % Ratings 2008	Load/ MW at Risk
207-1377	71%	0%	0	0%	
207-1378	0%	0%	0	0%	
532-1385	46%	0%	0	0%	
307-1351H	91%	16%	1.3	23%/	1.9
307-1352H	91%	16%	1.3	23%	1.9

Loading on Maynard #416 DSS lines.

14kV Distribution

Considering the very meager load growth the distribution circuits have sufficient capability. By 2008 one circuit 416-H1 is projected to reach 97% of its normal capacity with all lines in service. This heavy loading condition will be address by load transfers to adjacent Maynard distribution circuits. The following table shows the available capacity on the distribution circuits, respectively.

14 kV Radial Line	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
416-H1	92%	94%	97%
416-H2	72%	74%	77%
416-H3	56%	58%	61%
416-H4	61%	63%	68%
416-H5	68%	70%	72%
416-H6	79%	81%	83%
416-H7	86%	88%	91%

Loading on Maynard 14 kV Distribution Circuits.

4kV Station

Maynard #416 supplies one 4kV station: Maynard #355 (Acton Street). Upon the loss of one of its two 6.25 MVA transformers, the remaining transformer will not exceed its long-term emergency capacity. There is no load at risk in this event.

4 kV Station	2002 Peak	LTE Capacity	2004 Projection	2008 Projection
Maynard #355	5.9 MVA	7.5 MVA	6.1 MVA	6.3 MVA

Loading on 4 kV station fed from Maynard #416

Proposed Integrated Plan

The suggested actions in the table will address the concerns within the Maynard supply region. The primary focus of the plan is to expand Sudbury Sta #342 by replacing transformer 110B and the distribution switchgear. Sudbury Station #342 with 75 MVA of firm capacity has ample transformer capacity to be the foundation of an integrated plan to support the Sudbury-Maynard-Speen Street region's load beyond 2008. The new distribution switchgear at Sudbury Station will provide spare

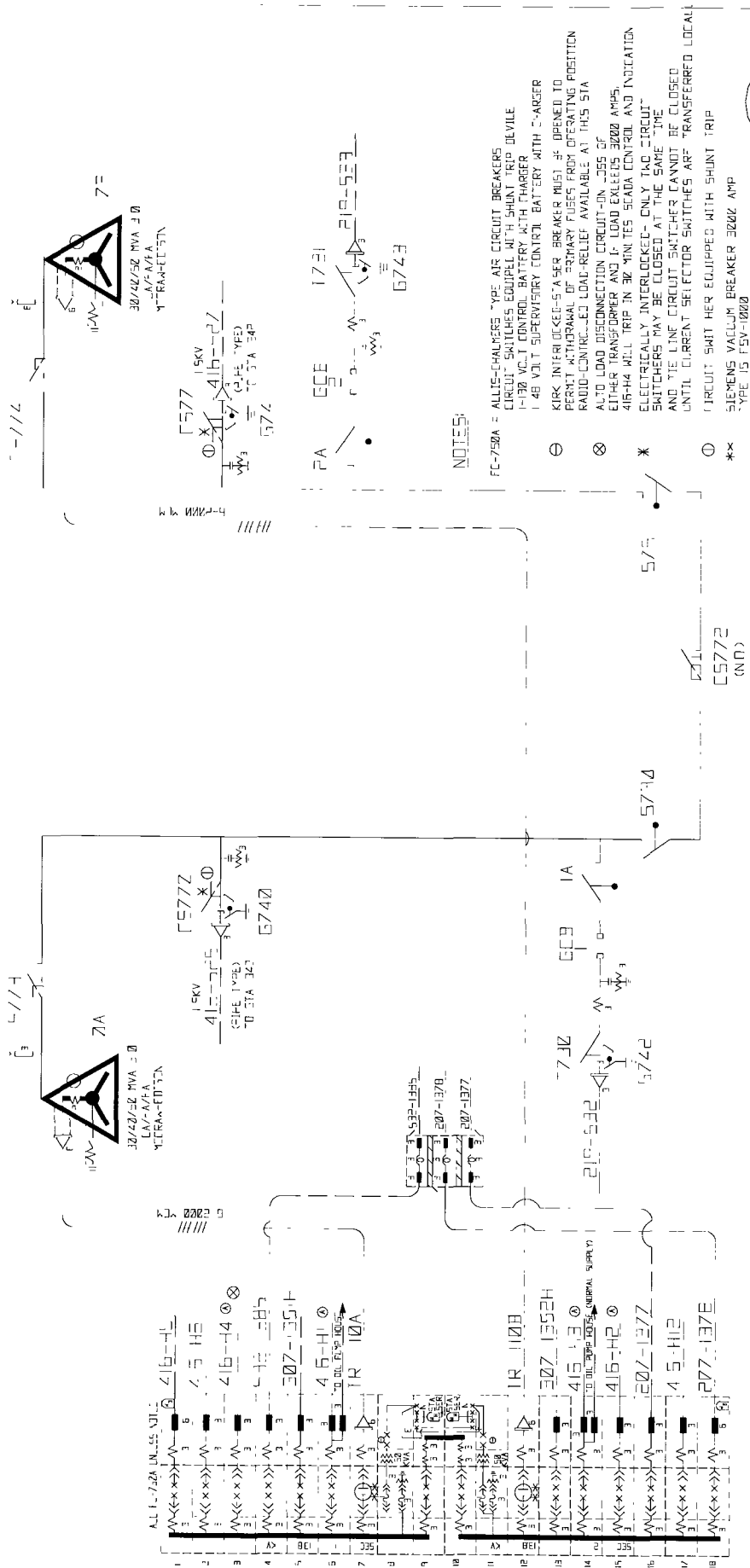
feeder positions that can support installation of new distribution circuits to relieve the heavily loaded Maynard Station #416 and to increase transfer switching between Sudbury and Maynard. Add a new feeder position at Maynard Station #416 and install a new distribution circuit to supply the distribution load presently on the Acton Line Group.

Action	Year needed	Cost
⇒ Install a new distribution circuit from Sudbury Sta #342 to relieve Maynard #416	2004-05	\$600K
⇒ Install a feeder position and distribution circuit at Maynard #416 to relieve heavily loaded Acton Line Group	2004-05	\$700K

U.S. DEPARTMENT OF JUSTICE
FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D.C. 20535

MANA

TEL: (617) 24 - 7933



BOSTON EDISON COMPANY
DELIVERY ENGINEERING DEPARTMENT

ELECTRICAL DESIGN DRAFTING GROUP

45

2004 T&D OPERATING STUDY FRAMINGHAM DISTRICT

STATION #433 SPEEN STREET

Speen Street Station #433 serves a power supply area consisting of portions of the towns of Framingham and Natick. During the summer of 2002, Speen Street Station load was 113 MVA.

Speen Street Station #433 consists of three 115/13.8 kV step-down transformers:

Transformer #110A: McGraw-Edison 30/40 [44.8] MVA 110/13.8 kV

Transformer #110B: McGraw-Edison 30/40 [44.8] MVA 110/13.8 kV

Transformer #110C: McGraw-Edison 60/80/100 [112] MVA 115/14.4/14.4 kV

Speen Street Station #433 has a total capacity of 180 MVA. NSTAR employs summer emergency rating (cyclic capability) for these three banks. Transformers 110A and 110B have a summer emergency rating (cyclic capability) of 50 MVA each. Transformer 110C has a summer emergency rating of 110 MVA. Station #433's firm capacity is 100 MVA. The RADSEC transfer switching capability to adjacent stations is 6.6 MVA. There is approximately 26.6 MVA of manual transfer switching that requires operating six non-RADSEC switches. Speen Street's load carrying capability is 133.2 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	30/40 [44.8] MVA	58 MVA	54 MVA
110B	30/40 [44.8] MVA	58 MVA	54 MVA
110C	60/80/100 [112] MVA	127 MVA	119 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
180 MVA	100 MVA*	6.6 MVA	26.6 MVA	133.2 MVA

* Based upon loss of 110C.

2004-2008 Projected load:

2004	2005	2006	2007	2008
131 MVA	132 MVA	132 MVA	135 MVA	136 MVA

Note A: The projected loads include the permanent load transfer of 8 MVA from Framingham Station #240 to Speen Street Station #433.

Switching Actions:

Loss of Transformer #110A or #110B and 342-507 Line:

- Open:** OCB's 5 & 6 @ Sudbury
OCB #2
Circuit Switcher #CS770
Main 110A 13.8kV Secondary Circuit Breaker
Main 110B 13.8kV Secondary Circuit Breaker
- Close:** ABR Scheme Closes 13.8kV Bus Tie Automatically
Manually close OCB's 5 & 6 @ Sudbury
Manually close OCB #2

Note: Due to station configuration, a forced outage of the #110A bank results in a forced outage of the #110B bank, and conversely, due to a lack of a disconnecting device on the 115kV side of these banks.

Loss of Transformer #110C and 433-507 Line:

- Open:** OCB's 7 & 8 @ Framingham
OCB #1
Circuit Switcher #CS771
Both Main #110C 13.8kV Secondary Circuit Breakers
- Close:** ABR Scheme Closes 13.8kV Bus Tie Automatically
Manually close OCB's 7 & 8 @ Framingham
Manually close OCB #1

For loss of either transformer, transfer of the following DSS lines via RADSEC and/or manual switches may also be required:

Framingham 240-H1 to Sherborn 274-H2 via RADSEC switches on P18/1 and P10/43 for a peak transfer of 2.2 MVA. This load is not removed from Speen Street Sta #433, however it creates capability for transfers below.

Speen Street 433-H11 to Framingham Station 240 H1 via a manual switch on P 1008/36D for a transfer of 8.7 MVA.

Speen Street 433-H8 to Framingham 240-H3 via SCAA MRU 169 P53/79 and manual switch on P53/84 for a transfer of 2.8 MVA

Speen Street 433-H12 to Framingham 240-H2 via manual switches on P 1008/19B and P1008/70B for a transfer of 8.0 MVA

Speen Street 433-H6 to Sudbury 342-H3 via SCAA MRU 836 on P28/50 and manual switch on P28/17 for a transfer of 2.8 MVA

Speen Street 433-H4 to Sudbury Station 342 and W. Framingham Station 455 via four possible switching arrangements:

Portion of 433-H4 to West Framingham 455-H4 via RADSEC switches on P 96/12 and P528/2 for a transfer of 3.8 MVA

Portion of 433-H4 to Sudbury 342-H4 via RADSEC switch on P 75/13 and manual switch P74/71 for a transfer of 2.8 MVA

Portion of 433-H4 to W. Framingham 455-H1 via RADSEC switches on P21/72 and P21/18 for a transfer of 2.8 MVA

Portion of 433-H4 to Sudbury 342-H4 via manual switch on P224/37 for a transfer of 1.5 MVA

Total Transfer: 33.2 MVA

Summary of Concerns:

1. Marginal voltage regulation for either the loss of transformers 110A/110B or 110C or 115kV supply lines 342-507 and 433-507
2. 14 kV Distribution circuits 433-H5 and 433-H6 (2004), 433-H4 (2005) and 433-H8 (2008) are overloaded under normal conditions (2004).
3. 4 kV station Saxonville #278 overloaded under contingency conditions (2004)
4. Speen Street Inadequate transformer capacity under contingency conditions (2007)
5. 4 kV lines 278-04 (2004) and 278-01 (2008) overloaded under normal conditions

Without any significant major development projects during 2002-2008, the Speen Street Supply region is projected to experience modest load growth; approximately 2.3% annual load growth. However due to heavy loading conditions at Leland Street Sta #240, 8 MVA of load Sta #240 was transferred to Speen Street Station #433 during the summer of 2003. As a result of this load transfer and the modest projected load growth starting in the summer of 2007 for a single-contingency outage of either transformers 110A/ 110B or transformer 110C, Speen Street Station #433 will exceed the load carrying capability (1% over LTE, 1.8 MVA load risk). Between 2007-2008 there is the potential for 1 MVA of new load and the station could attain a loading of 102% of LCC. The load at risk would increase to 2.8 MVA.

Distribution

DSS

The Saxonville Line Group consists of three DSS lines, 278-1343H, 278-1346 and 278-1347H. The line group is a loop supply between Speen Street Station #433 and Sudbury Station #342. The line group supplies NSTAR Station #278 Lake Road, Saxonville, Framingham and customer Station #338, Congress Group Ventures, Wayland. Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2004-2008 load projections. The following table provides details on the Speen Street's line 278 -1346 and 278-1347H.

DSS Line	% of Normal 2004	LTE - % of Rating	Load at Risk 2004	LTE - % Load at Risk 2008	Load at Risk 2008
278-1346	75%	0%	0	0%	0
278-1347H	60%	0%	0	0%	0

Loading on Speen Street DSS lines.

14kV Distribution

Nine of the twelve distribution circuits fed from Speen Street #433 have adequate capacity. In 2004 three circuits, 433-H4, H5 and H6, will reached or exceed 100% of its normal capacity with all lines in service. By 2008 another circuit 433-H8 is projected to exceed its normal capacity with all lines in service.

14 kV	% of	Projected % of	Projected %
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Radial Line	Normal 2002	Normal 2004	of Normal 2008
433-H1	83%	87%	91%
433-H2	35%	37%	38%
433-H3	72%	75%	78%
433-H4	96%	100%	104%
433-H5	104%	109%	114%
433-H6	99%	105%	110%
433-H7	70%	73%	79%
433-H8	93%	97%	100%
433-H9	44%	46%	48%
433-H10	75%	78%	81%
433-H11	77%	81%	84%
433-H12	0%	0%	0%
278-H1	60%	63%	66%

Loading on Speen Street 14 kV Distribution Circuits.

Speen Street #433 and Sudbury #342 supplies one 4kV station: Lake Road #278 (Acton Street). Upon the loss of one of its two 5.0 MVA transformers, the remaining transformer will exceed its long-term emergency capacity by 5% or more under heavy loading conditions. The load at risk in this event is over 300 KVA. The loading summarizes the capacity of the 4 kV station.

4kV Station

4 kV Station	2002 Peak	LTE Capacity	2004 Projection	2008 Projection
Saxonville #278	6.2 MVA	6.0 MVA	6.3 MVA	6.6 MVA

Loading on 4 kV station fed from Speen Street #433 and Sudbury #342

Proposed Integrated Plan

The suggested actions in the table will address the concerns within the Speen Street supply region. The primary focus of the plan is to expand Sudbury Sta #342 by replacing transformer 110B and the distribution switchgear. Sudbury Station #342 with 75 MVA of firm capacity has ample transformer capacity to be the foundation of an integrated plan to support the Sudbury-Maynard-Speen Street region's load beyond 2008. The new distribution switchgear at Sudbury Station will provide spare feeder positions that can support installation of new distribution circuits to relieve the heavily loaded distribution circuits within Speen Street Station #433 supply region and to increase transfer switching between Sudbury and Speen Street.

Action	Year needed	Cost
⇒ Install new distribution circuits at Sudbury #342 to relieve four Speen Street #433 circuits and heavy load at Station #433 (\$530K)	2004-05	\$530K
⇒ Convert 4 kV circuit 278-01 and 278-07 through 14 kV circuit 278-H1; relieve heavy loading of Saxonville Sta #278	2004	\$950K

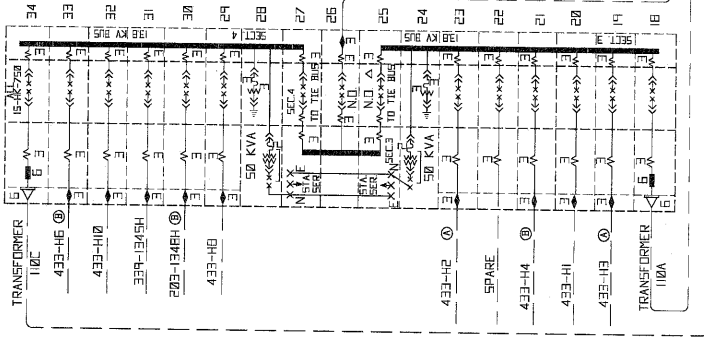
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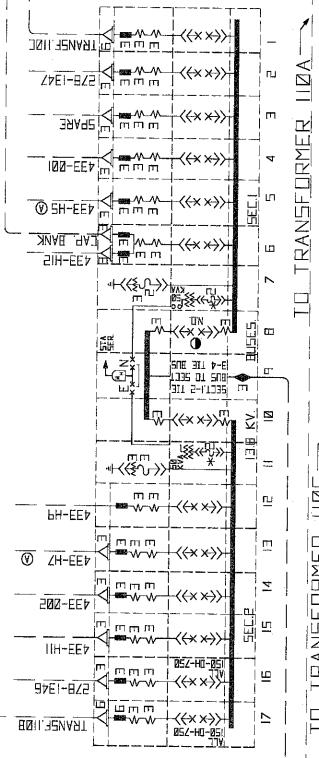
* AUTO BUS RESTORAL SCHEME
TO MANUAL BEFORE OPERATING
BUS TIE OR SECONDARY BREAKERS

* 433-HB
433-H4
433-H5
A.L.D. IN SERVICE
SEE SCADA

STATION 433
110 SPEEN STREET
FRAMINGHAM
TEL. # (617)-541-7938



- NOTES:
- 1-ADV CONTROL BATTERY W/CHARGER.
 - 2-CURRER SMITH ALARMING TO SIC
 - 3-15-5000-SECIL CIRCUIT BREAKERS
 - 4-15-5000-SECIL CIRCUIT BREAKERS
 - 5-15-5000-SECIL CIRCUIT BREAKERS
 - 6-15-5000-SECIL CIRCUIT BREAKERS
 - 7-15-5000-SECIL CIRCUIT BREAKERS
 - 8-15-5000-SECIL CIRCUIT BREAKERS
 - 9-15-5000-SECIL CIRCUIT BREAKERS
 - 10-15-5000-SECIL CIRCUIT BREAKERS
 - 11-15-5000-SECIL CIRCUIT BREAKERS
 - 12-15-5000-SECIL CIRCUIT BREAKERS
 - 13-15-5000-SECIL CIRCUIT BREAKERS
 - 14-15-5000-SECIL CIRCUIT BREAKERS
 - 15-15-5000-SECIL CIRCUIT BREAKERS
 - 16-15-5000-SECIL CIRCUIT BREAKERS
 - 17-15-5000-SECIL CIRCUIT BREAKERS
 - 18-15-5000-SECIL CIRCUIT BREAKERS
 - 19-15-5000-SECIL CIRCUIT BREAKERS
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 - 32-15-5000-SECIL CIRCUIT BREAKERS
 - 33-15-5000-SECIL CIRCUIT BREAKERS
 - 34-15-5000-SECIL CIRCUIT BREAKERS



BOSTON EDISON COMPANY
ENGINEERING SERVICES GROUP

DATE	REVISION	PER FIELD MARK-UP	DESCRIPTION	BY	CHECK
7/3/02	1	REVISOR	REVISOR	REVISOR	REVISOR
4/28/97	1	ADD L & ASSOCIATED NOT	ADD L & ASSOCIATED NOT	ADD L & ASSOCIATED NOT	ADD L & ASSOCIATED NOT

433

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2004 T&D OPERATING STUDY FRAMINGHAM DISTRICT

STATION #455 WEST FRAMINGHAM

West Framingham Station #455 supplies portions of the communities of Framingham, Ashland and Hopkinton. During the summer of 2002, West Framingham peak load was 55 MVA.

West Framingham Station #455 consists of two 115/13.8 kV transformers:

Transformer #110A: General Electric 30/40 [44.8] MVA 69 x 115/13.8 kV

Transformer #110B: General Electric 30/40 [44.8] MVA 69 x 115/13.8 kV

West Framingham Station #455 total capacity is 89.6 MVA. NSTAR employs summer emergency rating (cyclic capability) of 48 MVA for each of these two banks. Station #455's firm capacity is 48 MVA. West Framingham Station #274 has approximately 16 MVA of transfer switching to adjacent stations Hopkinton Sta #126, Framingham Sta #240, Sherborn Station #274, and Speen Street #433. Sherborn's load carrying capability is 64 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	30/40 [44.8] MVA	57 MVA	52 MVA
110B	30/40 [44.8] MVA	58 MVA	53 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
80 MVA	48 MVA*	8.7 MVA	8.3 MVA	65.0 MVA

* Based upon loss of 110B.

2004-2008 Projected load:

2004	2005	2006	2007	2008
60 MVA	60 MVA	61 MVA	62 MVA	63 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Breakers #1 and #2

Main 110A 13.8kV Secondary Circuit Breaker

Manually open disconnect Switch #T730

Close: ABR Scheme Closes 13.8kV Bus Tie Automatically

Manually close OCB's #1 and #2 to reconnect #513-507 line to W. Framingham 115kV bus.

Loss of Transformer #110B and 455-507 Line:

Open: OCB's 1 & 2 @ Sherborn

OCB #3

Circuit Switcher #CS770

Main #110B 13.8kV Secondary Circuit Breaker

Close: ABR Scheme Closes 13.8kV Bus Tie Automatically

Manually close OCB's 1 & 2 @ Sherborn

Manually close OCB #3 to reconnect the 455-507 to the W Framingham 115 KV bus.

For loss of either transformer, transfer of the following DSS lines via RADSEC and/or manual switches may also be required:

W. Framingham 455-H1 to Speen Street 433-H4 via RADSEC switch on P21/72 and a manual switch on P 652/1 for a transfer of 1.1 MVA

W. Framingham 455-H3 to Hopkinton 126-H4 via RADSEC switch on P122/1 for a transfer of 4.9 MVA

W. Framingham 455-H5 to Framingham Station #240 24-H1 via RADSEC switch on P 85/54 and manual switch on P141/13 for a transfer of 3.7 MVA

Speen Street 433-H4 to Sudbury 342-H5 via a RADSEC switch on P75/13 and a manual on P680/3 for a peak transfer of 2.8 MVA. This load is not removed from West Framingham Street Sta #455, however it creates capability for transfers below.

Framingham 455-H4 to Speen Street 433-H4 via RADSEC switches on P 96/12 and on P244/179 for a transfer of 3.7 MVA

Framingham 455-H5 to Hopkinton 126-H4 through 455-H3 via a manual switch on P244/247 for a transfer of 3.7 MVA

Total Transfer: 17.0 MVA

Summary of Concerns:

- No Concerns were identified during 2004-2008 time period.

Without any significant major development projects planned during the 2004-2008, the West Framingham Supply region is projected to experience meager load growth; approximately 1.1%. Based on the load projections, by the summer of 2008 for a single contingency outage of either transformer 110A or 110B, West Framingham Station #455 has adequate capacity to meet the load requirements and would be loaded to 97% of the load carrying capability.

West Framingham Station #455 contains seven distribution circuits, all of which have adequate capacity for the next few years, although 455-H2 and 455-H5 will be approaching their normal capacity between 2011 and 2013. There are no DSS lines at this station, and no 4 kV stations/circuits fed from this station.

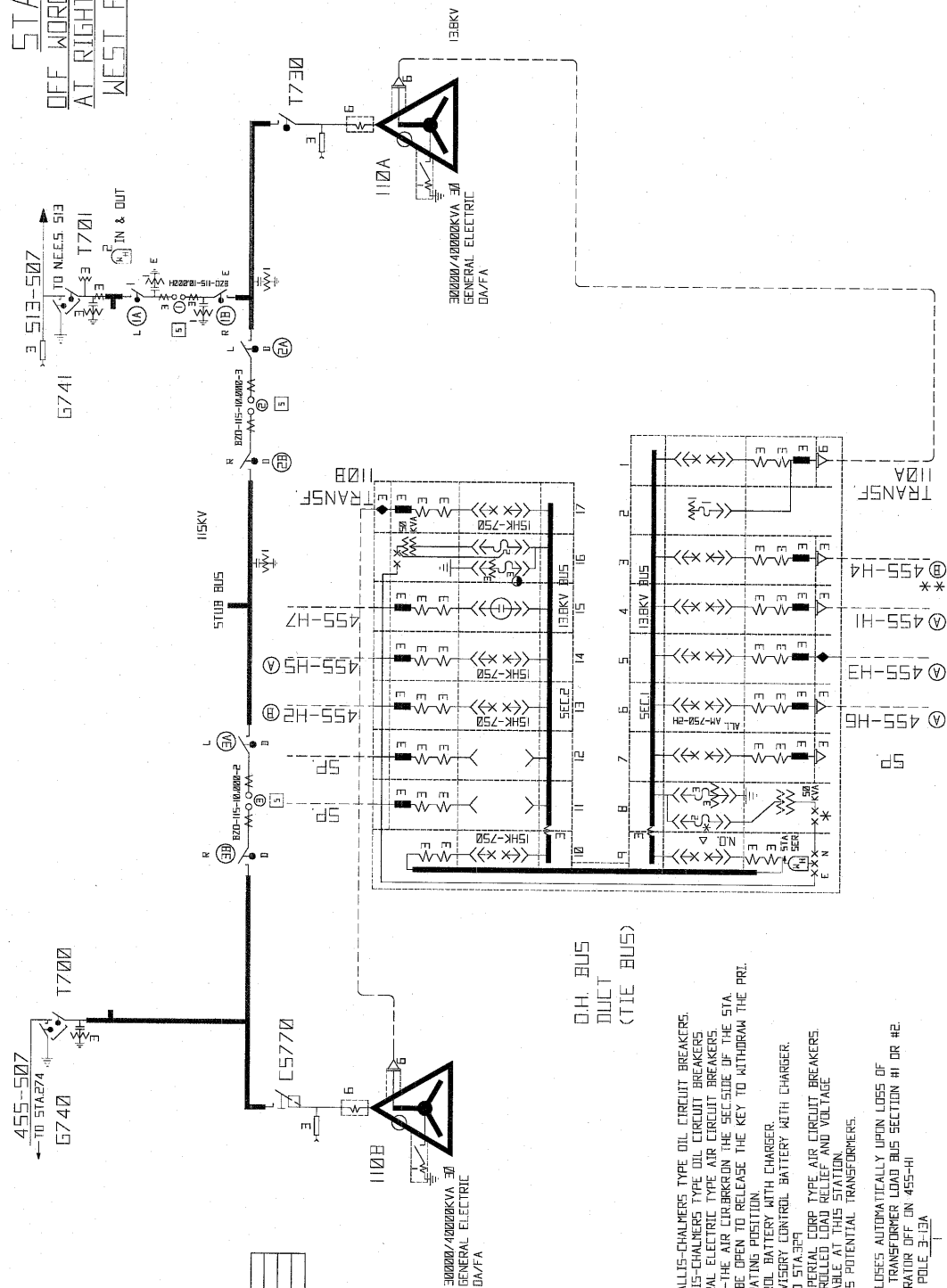
14 kV Circuit	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
455-H1	67%	73%	76%
455-H2	80%	88%	92%
455-H3	36%	39%	41%
455-H4	63%	69%	72%
455-H5	82%	90%	94%
455-H6	58%	63%	66%
455-H7	55%	60%	63%

Loading on West Framingham distribution circuits.

Actions Required:

Based on 2004-2008 load projections there are no actions required to supply the increased customer load within the West Framingham supply region during the 2004-2008 time period.

STATION 455
OFF WORCESTER ROAD
AT RIGHT-OF-WAY #3
WEST FRAMINGHAM
TEL# 370-4874



O.H. BUS
DUCT
(TIE BUS)

NOTES

- B70-115-50000-4=ALLIS-CHANDLER TYPE OIL CIRCUIT BREAKERS.
 B70-150-105=ALLIS-CHANDLER TYPE OIL CIRCUIT BREAKERS.
 H-750-2=GENERAL ELECTRIC TYPE AIR CIRCUIT BREAKERS.
 KEY INTERLOCKED-THE AIR CIRCUIT ON THE SECOND UP THE STA
 FUSER TRANS MUST BE OPEN TO RELEASE THE KEY TO WITHDRAW THE PRI.
 FUSES FROM OPERATING POSITION.
 1-130V VOLT CONTROL BATTERY WITH CHARGER.
 1-48V VOLT SUPERVISORY CONTROL BATTERY WITH CHARGER.
 CHARGER SWITCH TO 57A 320.
 15 H-750-2=GENERAL ELECTRIC COOP TYPE AIR CIRCUIT BREAKERS.
 BOTH RATIO CONTROLLED LOAD RELIEF AND VOLTAGE
 REDUCTION AVAILABLE AT THIS STATION.
 NON-STANDARD BUS POTENTIAL TRANSFORMERS.
 RATIO 12/12H
 NORMALLY OPEN-CLOSES AUTOMATICALLY UPON LOSS OF
 BUS POTENTIAL & TRANSFORMER LOAD BUS #2.
 MIRA HYDRO GENERATOR OFF ON 455-HI
 RIGHT OF WAY #3 POLE 3-13A

DATE	DESCRIPTION	WJB	CHK
6/27/02	REPLACED AUTOMATIC BKS WITH VACUUM BKS IN CUBICLE 5	WJB	
7/15/02	REVISED DME FOR BREAKER REPLACEMENT	EBA	
5/25/02	REVISED IAW-ENGRS MARK-UP	EBA	
6/23/02	RENOTIFIED BKR5 FOR CKT 2 & CKT 3	EBA	REB

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455

